FPL

DEC 2 1 2005

10 CFR § 50.73
L-2005-259

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: Turkey Point Unit 4
Docket No. 50-251
Reportable Event: 2005-002-01
Date of Event: June 27, 2005
Revised Automatic Reactor Trip due to Turkey Point Unit 4 Main Transformer Failure

The attached Licensee Event Report 50-251 / 2005-002-01 is being submitted pursuant to the requirements of 10 CFR 50.73(a)(2)(iv)(A) and 10 CFR 50.73(a)(2)(iv)(B)(6) to provide notification of the subject event. This LER submission contains supplemental information and supersedes the prior submission dated August 25, 2005 (Florida Power and Light Letter) L-2005-163.

If there are any questions, please call Mr. Walter Parker at (305) 246-6632.

Very truly yours,

Terry O. Jones
Vice President
Turkey Point Nuclear Plant

SM
Attachment

cc: Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, Turkey Point Nuclear Plant

IE22

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Turkey Point Unit 4	05000251	1 OF 5

4. TITLE

Revised Automatic Reactor Trip due to Turkey Point Unit 4 Main Transformer Failure

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	27	2005	2005	- 002 -	01	12	21	2005	FACILITY NAME	DOCKET NUMBER

9. OPERATING MODE

1

10. POWER LEVEL

100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: (Check all that apply)

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☒ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Stavroula Mihalakea - Licensing Engineer	305-246-6454

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
X	EL	XFMR	VA TEC ELIN	YES					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

On June 27, 2005, at 0316, Turkey Point Unit 4 reactor was automatically tripped from 100% power following a turbine trip due to a Main Generator lock out generated from an electrical fault of the Unit 4 Main Transformer. The transformer was recently installed during the refueling outage in Spring 2005. The fault ruptured the transformer tank releasing oil and caused a fire that damaged the transformer and adjacent equipment. At 0327, an Unusual Event was declared based on the fire in the plant protected area lasting longer than 10 minutes. The site fire brigade responded and extinguished the fire. Offsite fire fighting assistance was requested, but was not used to extinguish the fire. The fire was extinguished and the Unusual Event was terminated at 0500. All plant systems functioned as designed during and after the event. The operating crew controlled and stabilized the plant, and therefore the health and safety of the public was not adversely impacted by this event. The root cause for the Turkey Point Unit 4 Main Transformer failure was a failed manufacturing process employed by the vendor's supplier of the clamping ring. Corrective actions included replacement of the Main Transformer and repair/replacement of components damaged by the resultant fire.

DESCRIPTION OF THE EVENT

Turkey Point Units 3 and 4 were operating at 100% power. On June 27, 2005, at 0316, the Unit 4 experienced a Turbine-Generator trip resulting in an automatic Reactor trip [JD: RCT]. It was found later that the Turbine and Generator [TB] tripped as a result of an internal electrical fault initiated in the Unit 4 Main Transformer [EL:TB,XFMR].

Following the reactor trip, Operations entered 4-EOP-E-0, Reactor Trip or Safety Injection verified the Reactor and Turbine tripped and safety injection was not required. The Operating crew verified that the plant was stable and that the Auxiliary Feedwater System [BA] automatically actuated as designed (for transients that result in Steam Generator narrow range levels less than 10%).

The first indication of the transformer failure reached the control room at 03:16:14 on June 27, 2005. Trip signals were provided from several sets of protective relays. The Main Generator lockout relays [TB: RLY, 86] actuated and tripped the Unit 4 Generator breakers [TB:BRK], 8W65 and 8W88, as well as the Unit 4 Auxiliary Transformer breakers [TB:EB,XFMR,BKR] and caused an automatic fast transfer of the safety related 4160V busses. Both safety related 4160V busses [EB] 4A and 4B, as well as their respective loads, were energized via the Unit 4 Startup Transformer.

The electrical fault initiated a transformer pressure spike that resulted in the rupture of the transformer tank, the release of the transformer insulating oil and a damaging transformer fire. The plant fire team responded to the fire. The transformer deluge system [KP] actuated, slowing the fire down but not extinguishing it completely. At 03:27, the site emergency plan was activated and an Unusual Event was declared based on the fire in the plant protected area lasting longer than 10 minutes. Metro Dade Fire Department (offsite) assistance was requested, but it was not used to extinguish the fire. The fire was ultimately contained and extinguished by the onsite fire brigade in approximately 27 minutes from the beginning of the event. At 0343, the fire had been extinguished and the Hazardous Material Response Team was subsequently activated to control the transformer oil leak. The Unusual Event was terminated at 0500.

This event was reported to NRC (Event # 41800) in accordance with 10 CFR 50.72 (a)(1)(i), 10 CFR 50.72 (b)(2)(iv)(B) and 10 CFR 50.72 (b)(3) (iv)(A), and 10 CFR 50.72 (b)(2)(xi).

ANALYSIS OF THE EVENT

The Unit 4 Main Transformer is a three phase type TDQ-805A17D9K-99 transformer and is rated at 850 MVA with a voltage ratio of 22 kV to 245 kV. It was manufactured In 2004 and installed during the Unit 4 Spring 2005 refueling outage. The transformer was in operation for 14 days and it failed suddenly and without any warning. There were no annunciator alarms received prior to the fault occurrence. No evidence of any system, plant or Generator transient could be found occurring at the time of or in the hours before the failure.

Analysis of the plant and switchyard digital fault recorder traces show that the internal fault began as B phase to ground and propagated into multiple phase fault after approximately 1 second (60 cycles). This was evidenced by the abnormally high current flow into the transformer from both the switchyard and the Main Generator. The switchyard fault current contribution ceased in 4 ½ cycles when the Generator breakers 8W65 and 8W88 tripped open. However, there is no breaker for isolation between the Unit 4 Main Generator and the Unit 4 Main Transformer. As such, the Main Generator continued to contribute to the fault for an additional 11 seconds while coasting down, until the internal energy stored in the Generator field dissipated. The Generator fault current contribution was in excess of 44,000 Amps.

The pressure relief devices located at the top of the transformer actuated, but could not maintain the integrity of the main tank. The transformer seam at the top of the unit separated across the entire rear of the unit along the cooler banks and across a portion of the unit located under the conservator tank. The bolted flange for cooler bank 1 located on the top of the transformer was also separated, shearing some of the connecting bolts. These tank ruptures resulted in the release of transformer insulating oil and contributed to the fire. The Unit 4 Main Transformer was severely damaged and is not repairable. The fire charred the transformer body, the transformer control cables and conduit, and the transformer retaining pit.

Other plant equipment located in the proximity of the Main Transformer was damaged by the fire. These components included POV-3-4883 (Turkey Point Unit 3 Intake Cooling Water to Turbine Plant Cooling Water Header "A" Isolation valve) and associated control cables; the 480V cable run between the 4E load center (4B4106) and the non-vital 4B Motor Control Center (4B0651), as well as the associated conduits and cable tray; the Main Transformer deluge piping and control tubing; the transformer high side conductor A-frame support structures; and the transformer high side conductors. These components were addressed in the corrective action program and were either repaired or replaced prior to the Unit 4 restart. The fire damage did not impact safe shut down (Appendix R) capability.

In addition to the equipment damage, the Unit 4 Main Generator was subjected to abnormal stresses as a result of supplying fault current to the transformer for an extended period of time. The event necessitated a thorough examination of the Unit 4 Main Generator, including the Generator, excitation system, voltage regulator, isophase bus, and neutral bus. A thorough Unit 4 Main Generator inspection was performed. Minor damage, which was observed in the neutral bus, was repaired prior to the Unit 4 restart. The generator was re-certified for its normal service conditions.

Additionally, during the event, the Unit 4 Auxiliary Transformer was electrically connected to and exposed to the fire and subsequent deluge. However, no fault current flowed through the Auxiliary Transformer with the exception of any minor contribution from large motors being powered from the 4A and 4B switchgear at the time of the event. The current flowing through the Auxiliary Transformer ceased in less than 10 cycles when breakers 4AA05 and 4AB05 opened. Auxiliary Transformer testing was performed including power factor and insulation meggering as a precautionary measure. All testing was completed satisfactorily prior to Unit 4 restart.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Turkey Point Unit 4	05000251	2005	- 002	- 01	Page 4 of 5

TEXT *(If more space is required, use additional copies of NRC Form 366A)* (17)

The apparent cause of the event was a sudden internal fault on the B phase high side windings of the Main Transformer. The B phase high voltage cable had flashed through the cutout of the clamping ring nearest to the core. A root cause investigation was conducted which found no human error regarding the installation or operation of the Turkey Point Unit 4 Main Transformer. The damaged section of clamping ring was examined at the FPL laboratory. The clamping ring displayed a groove where the major arc penetrated the wood laminations. The clamping ring was constructed of high density laminated wood designed to maintain the series of windings in place and undamaged in the event of an external fault, and as an insulator that could prevent the flow of electricity between windings, or from a winding to ground. The vendor's supplier had performed a quality check by scanning the clamping rings for metal inclusions (not for voids) to disqualify the material for use in a dielectric stress environment if those were detected. The transformer vendor had only performed dimensional checks and a visual inspection. Analysis found that the laminated material used for the clamping ring was not a homogeneous product. The voids within the clamping ring material had degraded its dielectric properties resulting in the arc. The flash traveled from the high voltage cable, through the clamping ring, to a grounded tie plate near the core, causing the internal failure in the Main Transformer.

CAUSE OF THE EVENT

The root cause for the Turkey Point Unit 4 Main Transformer failure was a failed manufacturing process employed by the vendor's supplier of the clamping ring. The clamping ring contained a void which caused a partial discharge and provided a current fault path to ground for the B phase high voltage lead. A Contributing Factor to the Turkey Point Unit 4 Main Transformer failure was the Core form design, which requires the use of a clamping ring. Another Contributing Factor is that no recognized industry test could be found that would identify non-homogeneous laminated material used in the clamping ring after the transformer was assembled. One of the possible missed opportunities was not employing an independent consultant to review the transformer design proposed and to oversee the construction process.

REPORTABILITY

A review of the reporting requirements of 10 CFR 50.72 and 10 CFR 50.73 and NRC guidance provided in NUREG-1022, Revision 2, Event Reporting Guidelines 10 CFR 50.72 and 10 CFR 50.73, was performed for the subject condition. As a result of this review, the condition is reportable as described below.

10CFR50.73(a)(2)(iv)(A) states that the licensee shall report any event or condition that resulted in a manual or automatic actuation of any of the systems listed in 10CFR50.73(a)(2)(iv)(B). Systems to which the requirements of 10CFR50.73(a)(2)(iv)(A) apply include the Reactor Protection System actuation resulting in a automatic trip 10 CFR 50.73(a)(2)(iv)(B)(1). The event is also reportable in accordance with 10 CFR 50.73 (a)(2)(iv)(A), due to automatic AFW system actuation 10 CFR 50.73(a)(2)(iv)(B)(6).

ANALYSIS OF SAFETY SIGNIFICANCE

For this automatic reactor trip, the initial conditions were well within the assumed conditions of the Loss of External Electrical Load event analyzed in the Final Safety Analysis Report (FSAR). The plant was operating at 100% power. A 100% loss of load resulted in a reactor trip on turbine trip due to Main Generator Lock out. All plant systems functioned as designed during and after the event. The plant response was well within the FSAR minimum and maximum values compared to the Loss of External Electrical Load event.

The risk with respect to core damage and large early release frequency as a result of the transformer failure and fire have been assessed to be no different from any other unplanned reactor trip, since all automatic plant trip features functioned as designed resulting in a stable plant configuration. The deluge water did not challenge any accident mitigation function and the Main Transformer does not provide any accident mitigation capability. The transformer condition did not have an effect on the function of any Emergency Diesel Generator. The transformer fire did not have any adverse effect.

This event did not adversely impact the plant's ability to mitigate the consequences of an accident and therefore, had minimal safety significance.

CORRECTIVE ACTIONS

- Corrective actions included replacement of the Unit 4 Main Transformer and repair/replacement of other components damaged by fire.
- FPL will determine critical manufacturing attributes and provide means for adequate oversight during the manufacturing process of the replacement of all large PTN transformers.

ADDITIONAL INFORMATION

EIIS Codes are shown in the format [EIIS SYSTEM: IEEE system identifier, component function identifier, second component function identifier (if appropriate)].

No similar events were identified at Turkey Point. The Turkey Point Unit 3 Main Transformer was manufactured by the same vendor at the same factory in the same year, 2004, and using the same manufacturing procedures and methods. The Unit 3 main transformer is of the same type, rating, and ratio and it was installed during the Unit 3 refueling outage in October of 2004. FPL believes that the Unit's 3 Main Transformer has been in service past the point that a defect would have propagated into a failure.